Cell Viability of insulin-producing cells after injection into complex hydrogel shapes in macroencapsulation device

Can insulin production be restored in Type 1 Diabetics through injection molding to microencapsulate islet cells in complex hydrogel geometries?

Introduction

Type 1 Diabetes is characterized as the autoimmune attack of native pancreatic beta cells responsible for producing insulin and therefore regulating blood sugar (1). Current therapies for Type 1 Diabetes include continuous glucose monitors and insulin pumps. These methods require significant maintenance from the user, and have limited real-time accuracy. Current technology allows for donor islet transplantation to Type 1 Diabetics, however the host immune system has been shown to break down beta cells after a period of three years (2). To address this limitation in islet transplantation, this study proposes an injection molding device that allows microencapsulation of insulin-producing islet cells in biocompatible hydrogels that protect from the host immune system and may potentially restore natural insulin production while protecting islets from the host immune system.



Figure 1: Experimental flow of cell viability studies. Alginate hydrogel was mixed with INS-1E insulin-producing cells and activated with GDL in a lure lock syringe, then injected into the 3D printed mold and allowed to cross link. Spirals and control disks were stained with calcium and ethidium stains and imaged with a confocal microscope.



Camryn Garza, Biomedical Engineering Mentor: Jessica Weaver, Assistant Professor School of Biological and Health Systems Engineering



Figure 3: Cell viability confocal imaging of insulin-producing cells microencapsulated in spiral geometry compared to control disk. Cells were seeded at 5 islet equivalent concentration and incubated in cell media. Spirals were imaged at zero and 24 hours. Live cells fluoresce green and dead cells fluoresce purple.

Future Directions

Future experimentation to measure the efficacy of this injection molding device would be to increase time intervals of cell viability timepoints to test long-term viability of insulinproducing cells in the injection molding device. Additionally, experimentation may be done using pseudoislets rather than individual cells to assess the integrity of islets after the injection process in shear stress conditions. Cell metabolism assays such as Alamar blue assays may also be performed to assess cell metabolism alongside viability at various timepoints for the hydrogel molds.

References

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